CONTROLLER AND METHOD FOR CONTROLLING A CONTROL OBJECT

CROSS-REFERENCE TO RELATED CASE

The present case claims the benefit of the filing date of Swedish Patent Application Serial No. SE-0202933-8, filed October 3, 2002.

TECHNICAL FIELD

The invention relates to a controller and a method for controlling a maneuverable control object, which controller comprises a control lever and a number of detention devices for limiting the movement of the control lever.

BACKGROUND ART

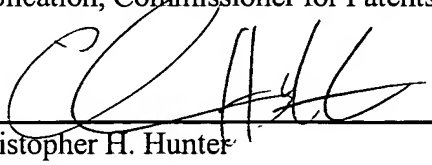
Controllers comprising a freely movable control lever, also referred to as "joystick", for controlling a maneuverable control object are generally previously known. Since such a control lever is freely movable in a number of directions; it can be a problem for an operator to move the control lever in one plane or about an axis through the pivot point of the control lever.

A previously known control lever of this kind can be seen, for example, from US 4 587 510-A. This device is provided with a pair of cross-laid clamps with slots along

---

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service on this 3rd day of October, 2003, in an envelope as "Express Mail, Post Office to Addressee" Mailing Label Number EV291967264US addressed to Mail Stop Patent Application, Commissioner for Patents P. O. Box 1450, Alexandria, Virginia 22313-1450.



Christopher H. Hunter

which the control lever can be guided. The sole function of the clamps is in this case to comprise fastening points for position-detecting transmitters which are used to monitor the position of the control lever in the guidance of a control object.

A further problem is that current solutions do not allow the control lever to be easily lockable in an optional position. A generally known solution in connection with control levers of this type is instead for them to return to a normal or neutral position when the operator lets go. One example of such a solution can be seen from EP 0 999 487-A2, in which the control lever is spring-loaded toward a central neutral position.

The invention also sets out to solve the aforementioned problems by limiting or wholly locking the movement of a control lever of the aforementioned type.

DISCLOSURE OF INVENTION

The object of the present invention is to be able to limit the movement of the lever, alternatively to wholly lock the control lever in certain positions. The said object is achieved by means of a controller and a method for controlling this, the characteristics of which can be seen from the Independent Patent Claims 1 and 12, and their subordinate claims.

According to a preferred first embodiment, the invention comprises a controller for controlling a maneuverable control object, which controller comprises a control lever designed to be manually maneuvered by an operator into various positions and a console in which the control lever is pivotable about at least two intersecting pivot axes and in which the console is provided with a corresponding number of clamps swivel-mounted about the said pivot axes. The clamps are provided with slots through which the control lever extends and along which the control lever can be led. Each cooperates with its respective detention device for locking the associated clamp in at least one predefined detention position and hence limiting the movement of the control lever. The detention devices can preferably be activated individually.

By the term "intersecting pivot axes" is meant that the pivot axes of all incorporated clamps are placed at an angle relative to one another. The angles between

respective pivot axes are chosen with regard to the desired function and pattern of movement.

According to one embodiment, the detention devices are designed to lock the control lever in at least one of a plurality of end positions in the said slots. The control lever can then be moved to an end position in the slot belonging to one of the clamps, whereupon a second, transverse clamp is locked. The control lever is thereupon movable in the slot belonging to the second, locked clamp.

According to a further, alternative embodiment, the detention devices can be designed to lock one of the said clamps in any one of a number of predefined positions, the control lever only being maneuverable in the slot of the locked clamp.

According to an alternative embodiment, the detention devices are designed to lock the control lever in an optional position between a pair of end positions in the said slots. As has been described above, the control lever is in this case movable in the slot belonging to the second, locked clamp.

In all three embodiments above, it is, of course, possible to choose freely which clamp is to be locked and .to lock a further clamp in order to lock the control lever in a fixed position.

The controller comprises at least one detention device for a respective clamp, in which each detention device comprises a detention arm. The detention arm is at its one end swivel-mounted in the console and extends transversely to the pivot axis for the respective clamp. It can also be provided with engagement members having a contact surface which, in the detention position, engages with a cooperating contact surface of the respective clamp.

The detention arm, at its other end, is provided with an activable member when activated, moves the detention arm into the detention position locking the clamp. An activatable member of this kind may comprise an electromagnet, a pneumatically or hydraulically operated piston-cylinder unit, a mechanically operated cam, or the like.

In certain cases it can be desirable for the detention devices only to be activable when the control lever is placed in certain predefined positions. In order to achieve this,

the console can be provided with some form of position transmitter, preferably a contactless transmitter, coupled to a control unit, for detecting the position of the control lever relative to the console.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in greater detail below based on an illustrative embodiment, with reference to the appended diagrammatic drawings.

Figure 1 shows a projection of a first embodiment of the device, in which the control lever is placed in one of its end positions;

Figure 2 shows a top view of the device in Figure 1 with the same control lever position;

Figure 3 shows a cross-section of the device in Figure 2 in the plane A-A;

Figure 4 shows a part-enlargement of the device in Figure 3, displaying the position transmitter of the control lever.

MODES FOR CARRYING OUT THE INVENTION

In the example shown in Figures 1, 2 and 3, the controller is constructed as follows. The principal parts are comprised by a control lever 1 and a control console 2 in which the control lever is pivotably mounted. The mounting is not shown in Figure 1 but may comprise a ball joint in the control console 2, or as a cardan suspension having two cross-laid pivot axes, forming a pivot point. The movement of the control lever 1 with respect to the swivel movement about the pivot point is determined by two cross-laid clamps 3, 4, which can be swiveled about their respective swivel axis 5, 6. In order not to disturb each other's movement, the clamps are arranged as an upper clamp 3 and a lower clamp 4. The two swivel axes 5, 6 of the clamps are cross-laid relative to each other, in the illustrated example perpendicular to each other. In addition to this, each end 7, 8, 9, 10 of each clamp 3, 4 is pivotably fastened by means of its respective pivot point to the control console 2. Each swivel axis is arranged in the form of a pivot pin 11,12, 13, 14 in a hole in a console section at each clamp end 7, 8, 9,10. The clamps 3, 4 are provided

with a respective longitudinal slot 15, 16, which slots are arranged to cross each other, the control lever 1 extending transversely through the slots 15, 16 at their point of intersection 17 (see Fig. 2). The slots 15; 16 are closed and have end edges 18, 19, 20, 21 which form end stops for the swivel movement of the control lever. The longitudinal edges 22, 23, 24, 25 of the slots 15, 16 form lateral guides for the control lever, the width of the slots with suitable tolerances somewhat exceeding the cross-dimension of the control lever, in this case its diameter. The control console 2 is arranged as a fixed plate with a number of fixing holes 26 for fixing the controller to a suitable base, for example an instrument panel, an arm rest or the like.

The controller according to a preferred embodiment is provided with two detention devices in the form of a pair of detention arms 27, 28. Each detention arm is at its one end mounted in a pivot point 29, 30. Such a mounting can comprise a spring-back device (not shown) made of an elastic material, or a spring which endeavours to hold the detention arm in an unloaded position. At its other end, the detention arm 27, 28 is provided with an activatable member in the form of an electromagnet 31, 32, which, when activated, moves the detention arm 27, 28 into a detention position for locking of the particular clamp 3, 4.

Each detention arm 27, 28 is provided with engagement members having a contact surface 33 which, in the detention position, engages with a cooperating contact surface 34 placed on the respective clamp 3, 4 in connection with one of the clamp ends 7, 9. The contact surface 34 of the respective clamp is preferably arranged as a part-cylindrical surface with a predefined radius relative to the swivel axis of the respective clamp. According to the embodiment shown in Figures 1-3, the contact surface of detention arm 27, 28 has a profile which allows cooperation between the respective contact surfaces 33, 34 when the control lever has been moved into bearing contact against the end edge 19 of the slot 15 in the upper clamp 3. The control lever is then locked in the end position of the upper clamp 3 but can be moved transversely to the said clamp 3 in the slot 16 of the lower clamp 4.

The detention arm is preferably exchangeable in order to allow functions and pattern of movement to be changed. A detention arm provided with an even contact surface 34 allows the respective clamp 3, 4 to be freely lockable in all positions along its guide slot 15, 16. A detention arm provided with contact surfaces 34 in the form of a recess in connection with both ends of the detention arm allows the respective clamp 3, 4 to be lockable in the respective end positions of the guide slots 15, 16. A detention arm provided with contact surfaces 34 in the form of a plurality of recesses in the lower side of the detention arm allows the respective clamp 3, 4 to be locked in a corresponding number of predefined positions.

According to an alternative embodiment, the said electromagnet may be a spring-loaded solenoid, in which case the solenoid can be used to return the detention arm to the unloaded position.

The activable member can also be comprised by a pneumatically or hydraulically operated piston/cylinder unit, a mechanically operated cam, or the like.

Figure 3 also shows an arrangement for returning the control lever to a central neutral position should none of the detention arms be activated when the operator lets go of the control lever. This arrangement comprises a fixed stop 37 mounted around the control lever 1, and a helical spring 38, which bears against the said stop 37 and spring loads a guide body 39 in the direction of the pivot point of the control lever. The guide element bears against a guide 40 placed in the upper part of the console 2. lf none of the detention devices are activated when the operator lets go of the control lever, the spring-loaded guide body 39 will be pressed against the guide 40 and move the control lever into a neutral position.

Figure 4 comprises an enlarged partial cross-section of Figure 3 and shows an arrangement comprising a sensor for indicating the instantaneous position of the control lever. The sensor is preferably contactless and is in a Hall sensor.

The ball joint of the control lever 1 is provided with a guide pin 41 placed on the diametrically opposite side of the ball joint relative to the control lever 1. The guide pin

41 cooperates with through guide slots in a pair of cross-laid clamps 42, 43 which are placed at right angles relative to each other and swiveled about their respective swivel axis 44. Each end of the respective clamp 42, 43 is pivotably fastened by means of its respective point to the control console 2.

The one end of the respective clamp 42, 43 is provided with a holder 45, 46, which bears a magnetic element in the form of a plurality of magnetic and negative poles 47 placed on each side of a Hall element 48, which, in turn, is mounted on a fixed-mounted holder 49. Each magnetic element is divided into a number of sectors, for example circular segments, whereby a displacement of the respective pair of magnets induces a current proportional to the position of the clamp in the Hall element By using a pair of Hall elements cooperating with magnetic elements fixed to two cross-laid clamps 42, 43 controlled by the guide pin 41, a position sensor is obtained whose output signal indicates the position of the control lever 1. The respective Hall element 47, 48 is coupled to a control unit 50, which is programmed to execute certain predefined measures depending on the signals from the sensor.

Activation of the detention devices for locking of the control lever can be effected in a number of different ways. For example, one or both detention devices can be activated automatically when the control lever is brought to a certain position. When the position sensor indicates such a position, one or both of the electromagnets is/are switched on and locks the control lever. This can be done directly or with a certain time delay. Alternatively, the locking can also be activated manually. Release of the detention is expediently effected manually. This can either be done with a simple changeover switch or in combination with some other measure. This latter can be relevant when the operator has to keep hold of the control lever when the detention is released, should it not be desirable for the control lever to return to its neutral position when freed. Alternatively, this can be achieved by placing a changeover switch on the control lever.

The preferred example above shows two clamps disposed with their swivel axes arranged perpendicular to each other. Depending on the desired function and/or pattern of movement, it is also possible to choose a different angle between the swivel axes. In

certain cases, it can also be desirable to provide the console with one or more further clamps, in addition to those described above, with a view to allowing rectilinear displacement of the control lever in a number of planes. In these cases too, the functioning of the device with cooperating slotted clamps with associated detention devices is, however, the same.